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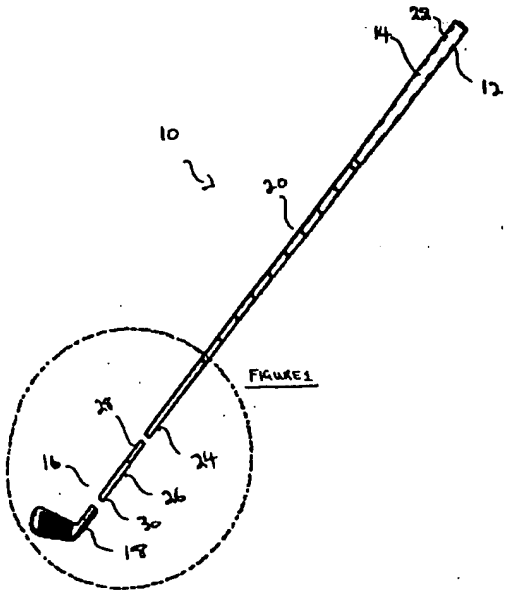
## (54) Golf club shaft

(57) The invention relates to a golf club shaft made from two parts. The shaft is designed to dampen vibrations and stabilise the club head.

The golf club shaft includes a first member having a first end located at the butt end of the golf club shaft and a second end positioned towards the distal end of the golf club shaft. The shaft further includes a second member secured to the second end of the first member and extending to the distal end of the golf club shaft. The first member is formed from a rigid material offering mechanical consistency and the second member is formed from a vibration absorbing material which absorbs undesirable vibrations.




EP 1 084 737 A2

## Description

**[0001]** The invention relates to a golf club shaft. More particularly, the invention relates to a two-piece golf club shaft adopted to dampen vibrations created upon the striking of a golf ball, stabilise the club head secured at the distal end of the shaft and control shaft flexing and torsional displacement in the shaft region adjacent to the club head.

**[0002]** Since golf clubs have been manufactured in sets, it has been an objective in the manufacture of golf clubs to achieve a degree of consistency such that variations between clubs occur within a predictable pattern. In the early days of golf, wooden shafts, most often made from hickory, were used for golf clubs. It was difficult to math a set of golf clubs with these wooden shafts. Occasionally players with an extraordinary feel could find a set of clubs that were fairly closely matched by individually testing each club until a proper feel was obtained.

**[0003]** With the advent of steel golf club shafts, wooden shafts became a thing of the past. Steel is isotropic in nature and, therefore, provides the mechanical consistency to enable a set of golf clubs to be closely matched in playability.

**[0004]** In recent years, golf club shafts have been made from carbon fibre composites, commonly known as graphite shafts. The graphite shafts have an increased strength to weight characteristic which allows a shaft, and ultimately a golf club, to be made lighter. In addition, graphite provides an increased vibration absorption capability, thereby creating a softer feel when a club impacts a golf ball. The ability of carbon fibre composite shafts to absorb vibrations generated upon striking a golf ball is not only favourable in improving the general feel of a golf club but is immensely valuable to those suffering from various physical ailments, including arthritis or tendonitis.

**[0005]** Graphite shafts are typically made by wrapping flags of resin pre-pregged carbon fibre on a mandrill and suitably curing the resin in an oven. Other graphite shafts are made by winding a pre-pregged carbon fibre tow on a mandrill and hearing to cure the epoxy.

**[0006]** While carbon fibre composite shafts are generally lighter than prior steel shafts, they exhibit a variety of shortcomings. For example, carbon fibre shafts are commonly inconsistent in feel and mechanical properties. From a manufacturing perspective, it is very difficult and expensive to generate matched sets of golf clubs utilising carbon fibre composite shafts. Currently there is no cost effective way to produce, in volume, shafts overcoming the shortcomings discussed above.

**[0007]** With this in mind, the manufacture of a set of consistently playable irons is very difficult where on wishes to utilise carbon fibre composite shafts. The relative mechanical inconsistency of the carbon fibre composite materials makes for a set of irons with widely varying playability. This inconsistency is highly undesirable where golfers wish to clearly utilise a set of interrelated golf clubs having the same feel and mechanical characteristics.

**[0008]** Attempts have been made in the past to create a two-piece composite golf shaft. For example, U.S. Patent No, 4,836,545 to Pompa, is directed to a two-piece composite golf shaft having a lower metallic tip section and an upper butt section made of a fibre resin composite or graphite, the term commonly used in the golf industry. The two sections are telescopically fitted together and bonded. However, the two-piece composite gold shaft disclosed by Pompa fails to provide a golf shaft exhibiting the desired mechanical consistency, vibration dampening, stabilisation and flex varying characteristics desired by a wide range of golfers.

**[0009]** In addition, Pat Simmons attempted to develop a steel/graphite shaft in the mid 1970s. The shaft included an upper section composed of steel and a lower section composed of graphite. The lower section accounted for approximately 30% of the total length of the golf club shaft. Simmons' shaft, however, failed to take advantage of the position features of steel and graphite. Specifically, the length of the lower section maintained many of the negative features of graphite in the composite shaft, while providing a structure which readily broke under the force of striking a golf ball. In addition, the length of the lower section took away the bending and consistency provided by a standard steel shaft.

**[0010]** As such, a need exists for a golf shaft providing the bending stiffness, torsional rigidity and consistency of standard steel with the vibration absorption characteristics of fibre reinforced resins in a manner which may be cost effectively controlled to create different configurations to match a variety of golfers' needs.

**[0011]** It is thus an object of the present invention to provide a golf club which has the feel and shock absorbing characteristics of a graphite or composite shaft whilst also having the consistency of a steel shaft.

**[0012]** It is also an object of the present invention to produce composite shafts having a consistent mechanical nature and being suitable for use in matched sets of golf clubs. It is thus an aim to provide a golf club shaft which lends itself to volume production.

**[0013]** It is also an object of the invention to provide a draft in which one of the components is used to control the bending and the torsional stiffness of the club head of the golf club.

**[0014]** It is further object of the present invention to provide a method for manufacturing a golf club shaft having a distal end and butt end.

**[0015]** The present invention provides such a golf club shaft.

**[0016]** According to one aspect of the present invention, there is provided a golf club shaft having a distal end and butt end, comprising:

a first member including a first end located at the butt end of the golf club shaft and a second end positioned towards the distal end of the golf club shaft;

a second member secured to the second end of the first member, the second member extending from the second end of the first member to the distal end of the golf club shaft and including a first end securely coupled to the second end of the first member and a second end which is ultimately secured to a golf club head;

the first member being formed from a rigid material and the second member being formed from a vibration absorbing synthetic composite material.

**[0017]** According to another aspect of the present invention, there is provided a method for manufacturing a golf club shaft having a distal end and butt end, wherein the golf club shaft includes: a first member having a first end located at the butt end of the golf club shaft and a second end positioned towards the distal end of the golf club shaft; and a second member secured to the second end of the first member, the second member extending from the second end of the first member to the distal end of the golf club shaft and including a first end securely coupled to the second end of the first member and a second end which is ultimately secured to a golf club head, the method comprising the steps of:

selecting a first rigid member;

selecting a second member composed of synthetic composite material; and

securely coupling the first end of the second member to the second end of the first member to complete assembly of the golf club shaft.

**[0018]** As with all golf club shafts, the shaft of the present invention has a butt end where the club is gripped by its user and a tip, or distal end, where a golf club head is secured to the shaft.

**[0019]** The golf club shaft includes a first member having a first end located at the butt end (i.e. the grip end) of the golf club shaft and a second end positioned slightly short of the distal end of the golf club shaft. The shaft further includes a second member secured to the second end of the first member. The second member extends from the second end of the first member to the distal end (i.e. the head end) of the golf club shaft. The second member includes a first end securely coupled to the second end of the first member and a second end which is ultimately secured to a golf club head.

**[0020]** The first member is formed from a rigid material offering mechanical consistency. The second member is formed from a material which absorbs undesirable vibrations resulting from an individual striking a golf ball and can be designed in configurations to produce a variety of desired torsional and longitudinal flex parameters.

**[0021]** The second member is formed from a material which is used to control the bending and torsional stiffness of the distal end of the golf club shaft upon striking a golf ball (ie, controlling the torsional stiffness of the golf club) thereby to stabilise a golf club head secured to the distal end of the golf club shaft. By varying the physical properties of this material it is possible to control the amount of torsion and bending acting on the club head despite the presence of the first, rigid, member forming part of the shaft. In this way, a desired set of consistent mechanical characteristics is created during the impact of the club head and ball.

**[0022]** The method of manufacturing the shaft of the present invention involves selecting a first member offering mechanical consistency, selecting a second member having predetermined flex characteristics chosen to suit a specific golf swing, and securely coupling the first end of the second member to the second end of the first member to complete assembly of the golf club shaft.

**[0023]** The present invention will now be illustrated by way of example only with reference to the following drawings in which:

Figure 1 is an exploded view of a golf club with the golf club shaft in accordance with the present invention.

Figure 2 is a detailed view of the distal end of the golf club.

Figure 3 is a partial cross sectional view of the second member.

Figure 4 and 5 are comparative charts showing the results of vibrational testing for steel and G10 composite material respectively.

**[0024]** With reference to Figures 1 and 2, a golf club shaft 10 in accordance with the present invention is disclosed. The shaft 10 is substantially shaped as a conventional golf club shaft and includes a butt end 12 to which a grip 14 is secured and a distal end 16 to which a golf club head 18 is secured.

**[0025]** The golf club shaft 10 of the present invention is constructed from a first member 20 including a first end 22 and a second end 24. The first member 22 extends from the first end 22 located at the butt end 12 of the shaft 10 to its second end 24 positioned slightly short of, or above, i.e. towards the distal end 16 of the golf club shaft 10.

**[0026]** A second member 26 is secured to the second end 24 of the first member 20 and extends axially

from the second end 24 of the first member 20 to the distal end 16 of the golf club shaft 10. The second member 26 accordingly includes a first end 24 which is secured directly to the second end 24 of the first member 20 and a second end 30 which is ultimately secured to the golf club head 18.

**[0027]** A preferred embodiment of the present shaft 10 employs a second member 26 with an exposed length of approximately 2 inches, that is, the portion of the second member 26 exposed between the second end 24 of the first member 22 and the hosel 31 of the golf club head 18, while the remaining length of the golf club shaft 10 is composed of the first member 20. Whilst a specific length is disclosed in accordance with a preferred embodiment of the present invention, the length of the second member 26 may be varied as discussed below. For example, and as discussed in additional detail below, it is contemplated that the exposed portion is preferably less than approximately 5½ inches (an 8 inch second member with 1¼ inch sections respectively inserted within the hosel and first member upon assembly), and more preferably, the exposed portion is between 1 inch and 3 inches. Ideally, the exposed portion is about 2 inches.

**[0028]** In accordance with a preferred embodiment of the present invention, the first member is constructed from a standard golf shaft grade metal, or metal matrix, preferably a carbon steel. As such, the flexibility of the steel first member 20 may be selected to suit the swings of different golfers. It is also contemplated that the first member may be manufactured from a variety of other materials, but preferably materials that are isotropic so that their mechanical features are consistent.

**[0029]** The first member 20 is shaped and dimensioned to resemble a typical golf club shaft as it extends from the butt end 12 of the golf club shaft 10 toward the distal end 16 of the golf club shaft 10. The only difference being that the first member 20 ends at a position short of the distal end 16 of the golf club shaft 10, thereby providing space for the placement of the second member 26 between the first member 20 and the golf club head 18. In fact, and in accordance with a preferred embodiment of the present invention, the first member 20 is formed by simply removing a preselected length of the tip end of a standard shaft, such as by way of example, the bottom 3¼ inches from a standard steel golf shaft.

**[0030]** The second member 26 is preferably a composite material chosen to dampen the vibrations coming from the club head 18 upon impact with a golf ball. The composite material, which is preferably a synthetic chemical compound, may be chosen to further improve the striking characteristics of a golf club by stabilising the club head 18 upon impact with a golf ball and varying the flex characteristics of the golf club shaft 10 to suit different golfers.

**[0031]** The second member 26 includes a male attachment member 32 shaped and dimensioned to fit within the opening 33 provided in the second end 24 of the tubular steel shaft making up the first member 20. While the disclosed embodiment employs a second member with a male attachment member for positioning within the first member, it is possible to vary the nature of the attachment (for example, providing the second member with a female attachment member).

**[0032]** In accordance with a preferred embodiment of the invention, the attachment member 32 is formed with an outer diameter of approximately 0.335 inches. The remainder of the second member 26 is the main body 34 and is shaped to match the profile of a conventional golf club shaft at the position adjacent the distal end of the golf club shaft (for example, 0.395 - 0.400 inches in diameter). With that in mind, the free end 36 of the body 34 is shaped and dimensioned to fit within the hosel 38 of the golf club head 18 for attachment of the present golf club shaft 10 to the club head 18. In other words, the opening in the hosel is slightly greater than the diameter of the main body of the second member so that the free end of main body of the second member can be inserted into the hosel and epoxied into place.

**[0033]** The male attachment member 32 is slightly smaller than the opening 33 provided in the second end 24 of the first member 20 and is shaped to be compression fit therein. A secure attachment between the first and second members 20, 26 is ensured through the application of epoxy or similar adhesive at the joint connecting the first and second members 20, 26.

**[0034]** In accordance with a preferred embodiment of the present invention, and with reference to Figure 3, the second member is formed from a carbon filter reinforced laminated plastic, manufactured by Current Laminated Plastics, Inc.

**[0035]** The carbon fibre reinforced laminated plastic material is formed from carbon fibre cloth. In this particular embodiment, the cloth is 8 feet wide by 1000 yards long, with the carbon fibres being oriented only in a lengthwise direction. In an illustrative process, the carbon fibre cloth is run through a resin bath and subsequently through an oven where the resin is cured. The resin coated cloth is then cut into 200 yard long rolls, and from the rolls it is cut into 8 foot lengths using a sheeting machine. The 8 foot long sheets of resin coated cloth are cut to 50 inch widths and then stacked to a depth of ½ inches so that the stack assumes a dimension 50 inches by ½ inch by 8 feet. The stacked sheets are subsequently put into a laminating press which applies heat under pressure to activate the resin and the stack of sheets are left in the press for approximately two hours.

**[0036]** The resulting blocks of laminate material removed from the laminating press are cut to a 4 foot lengths, and subsequently into elongated bars of the laminated material. The bars have a dimension of ½ inch by ½ inch by 4 feet, with the laminations extending perpendicularly to the length of the bars. The bars are then turned on a lathe and machined into a cylindrical

configuration that is, by way of example, approximately 0.395 inches in diameter. Thereafter, spaced segments of the cylindrical bar are further reduced to a diameter of, for example, 0.335 inches (to create the male attachment members 32). The reduced diameter portions of the cylindrical bar are, for example, approximately 1¼ inches long and are spaced, for example, approximately 3¼ inches apart. The cylindrical bar is then cut into a plurality of pieces that are approximately 4½ inches in length, with the cuts occurring at the same ends of the reduced diameter portions of the cylindrical bar. The individual pieces formed from the cylindrical bar constitute a preferred embodiment of the second member 26 of the golf shaft of the present invention.

**[0037]** The carbon fibre resin laminated plastic can produce very stiff second members which may be desirable to those golfers desiring a stiffer shaft with minimal vibration. In contrast to graphite shafts previously used throughout the golf industry, the second member formed from composite materials in accordance with the present invention exhibits exceptional consistency in a highly repeatable product.

**[0038]** The second member 26 may be formed from other composite materials in accordance with the present invention. We have found that similar results are also achieved by second members manufactured from G10, fibreglass reinforced resin laminated plastic, manufactured by Current Laminated Plastics, Inc. Second members made from fibreglass reinforced resin laminated plastic are manufactured in a manner substantially identical to the second members manufactured from carbon fibre reinforced laminated plastics discussed above.

**[0039]** While a specific method for manufacturing the second member from carbon fibre reinforced resin laminate blank is disclosed above, other methods may also be used in the manufacture of the second member 26. For example, it is contemplated that the carbon fibre or fibreglass reinforced second members may be manufactured by injection molding, mandrel wraps as commonly used in the manufacture of current hollow graphite shafts or other techniques commonly used in the manufacture of resin based products.

**[0040]** As briefly discussed above, the second member is preferably formed with an exposed length of approximately 2 inches. The second member is, therefore, formed as a 4½ inch solid cylinder with a male attachment member 32 having a length of approximately 1¼ inches. The free end 36 of the second member 26 is designed for insertion within the hosel 38 of a standard golf club head 18. For example, approximately 1¼ inches of the second member 26 are inserted within the hosel 38, leaving a length of approximately 2 inches as the exposed length of the second member.

**[0041]** As discussed above, the exact lengths of the first and second members 20, 26 are not critical to the overall function of the present invention, and these lengths may be varied according to the desired playing characteristics of the shaft.

**[0042]** It is contemplated that while the preferred embodiment is constructed with a 4½ inch long second member 26, the second member 26 should be constructed with a length of less than approximately 8 inches. The choice of 8 inches as the preferred maximum length is based upon the understanding that it is accepted in golf, through empirical research, that only the first 8 inches of a shaft (from the tip end) determine the playability characteristics during of impact. In fact, the characteristics of the shaft beyond 8 inches do not affect the shaft performance at the time of impact.

**[0043]** The resulting golf club shaft 10 manufactured from first and second members 20, 26 as discussed above exhibits many of the advantages of steel shafts, without the shortcomings of steel shafts. Specifically, the resulting golf club shaft 10 offers the consistency of a steel shaft without the vibrations considered undesirable by many golfers. In addition, the resulting golf club shaft 10 is similar to steel shafts in weight, balance point, bending stiffness (ie, shaft flex), torsional stiffness and longitudinal stiffness (ie, the response of the shaft to pulling from opposite ends of the shaft). The present golf club shaft 10 thereby provides the consistency of steel at the point where the shaft flexes, and the feel and playability of fibre reinforced resins where most of the shock is absorbed, thus minimising vibrations transmitted up the shaft to the hands of a golfer.

**[0044]** Vibrational tests have been performed on the golf club shaft discussed above with impressive results. The tested golf club shafts were constructed with a True Temper Dynamic Golf S300 taper steel shaft with 3¼ inches cut from the tip of the shaft (the first member) and a 4½ inch long solid cylinder made from G10 in the manner discussed above (the second member). The first and second members were assembled by placing the male attachment member of the second member within the second end of the first member and using epoxy to securely bond the first and second members together.

**[0045]** The results of the tests are shown in Figures 4 and 5. Figure 4 shows the vibration profile for a complete steel shaft. The high amplitude peaks with narrow bases exhibited by the steel shaft demonstrate substantial undesirable vibrations. Figure 5 shows the vibration profile for the golf club shaft 10 manufactured in accordance with the present invention. The present golf club shaft 10 exhibits lower amplitude peaks with much wider bases. The lower amplitude peaks and wider bases demonstrate the clear reduction in vibrations resulting from the use of the present golf club shaft.

**[0046]** The use of distinct first and second members in accordance with the present invention allows for the manufacturing of golf club shafts tailored to suit the specific needs of individual golfers. Specifically, the second member may be readily varied to alter the following characteristics of a golf club shaft: torsional stiffness (torque), bending stiffness (shaft flex), longitudinal stiff-

ness and dampening. For example, the material of the second member be composited to form a variety of consistent bending flex characteristics at the distal end of the golf club. As a result, the overall feel of the present shaft may be matched to a specific golfer's swing by varying the first and second member to provide optimum performance.

**[0047]** In addition to the many advantages discussed above, the present invention permits the manipulation of graphite characteristics in an economical manner. For example, if a company currently wished to come out with a production line of graphite shafts having specific consistent mechanical characteristics, they would be forced to purchase thousands and thousands of shafts, which would then be individually tested against each other to try to come up with as many matched sets as possible. The remaining shafts would then be thrown away or sold at a loss. The use of steel shaft members, small carbon fibre second members, and highly consistent carbon fibre second members in accordance with the present invention allows for the manipulation of graphite characteristics in a far more economical manner.

**Claims**

1. A golf club shaft having a distal end and butt end, comprising:

   a first member including a first end located at the butt end of the golf club shaft and a second end positioned towards the distal end of the golf club shaft;

   a second member secured to the second end of the first member, the second member extending from the second end of the first member to the distal end of the golf club shaft and including a first end securely coupled to the second end of the first member and a second end which is ultimately secured to a golf club head;

   the first member being formed from a rigid material and the second member being formed from a vibration absorbing synthetic composite material.

2. The golf club shaft according to claim 1, wherein the second member is formed from a fibreglass reinforced resin.

3. The golf club shaft according to claim 2, wherein the fibreglass reinforced resin is a fibreglass reinforced laminated plastic.

4. The golf club shaft according to claim 1, wherein the second member is formed from a carbon fibre reinforced resin.

5. The golf club shaft according to claim 4, wherein the carbon fibre reinforced resin is a carbon fibre reinforced laminated plastic.

6. The golf club shaft according to any preceding claim, wherein the first member is formed from a metal.

7. The golf club shaft according to claim 6, wherein the first member is formed from steel.

8. The golf club shaft according to any preceding claim, wherein the exposed length of the second member is between 1 and 3 inches, and is preferably 2 inches.

9. The golf club shaft according to any preceding claim, wherein the second member has a main body with a diameter of from 0.335 inches to 0.400 inches.

10. The golf club shaft according to any preceding claim, wherein the second member is no greater than 8 inches in length.

11. The golf club shaft according to any preceding claim, wherein the second member is a solid core construction.

12. A method for manufacturing a golf club shaft having a distal end and butt end, wherein the golf club shaft includes: a first member having a first end located at the butt end of the golf club shaft and a second end positioned towards the distal end of the golf club shaft; and a second member secured to the second end of the first member, the second member extending from the second end of the first member to the distal end of the golf club shaft and including a first end securely coupled to the second end of the first member and a second end which is ultimately secured to a golf club head, the method comprising the steps of:

    selecting a first rigid member;

    selecting a second member composed of a synthetic composite material; and

    securely coupling the first end of the second member to the second end of the first member to complete assembly of the golf club shaft.

13. The method according to claim 12, wherein the structural characteristics are chosen from the group consisting of torsional stiffness, bending stiffness and dampening.

14. The method according to claim 12 or 13, wherein the step of selecting the second member includes manufacturing the second member from a fibre-glass reinforced resin.

15. The method according to claim 12 or 13, wherein the step of selecting the second member includes manufacturing the second member from a carbon fibre reinforced resin.

16. The method according to any of claims 12 to 15, wherein the first member is formed from steel.

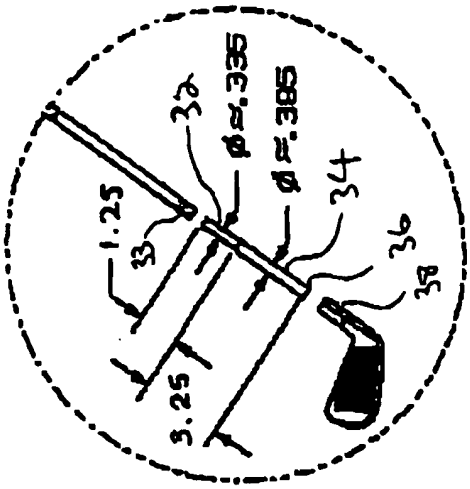



FIGURE 2

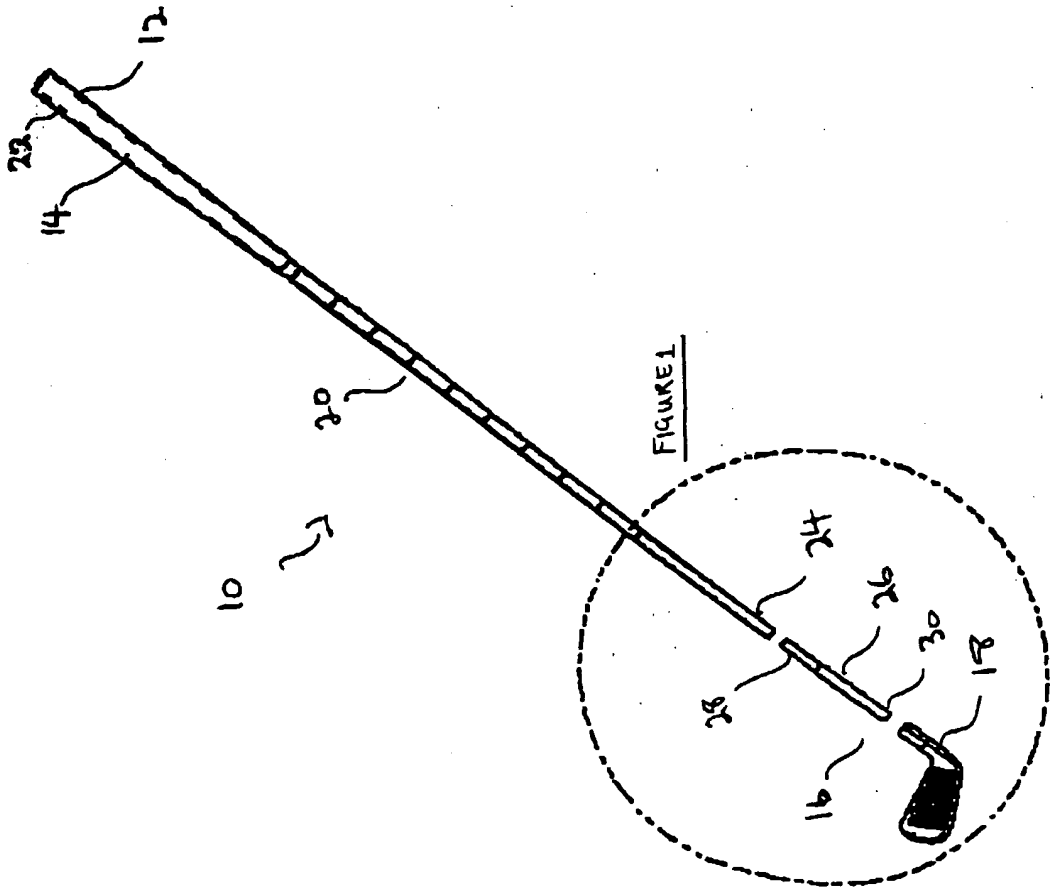



FIGURE 1

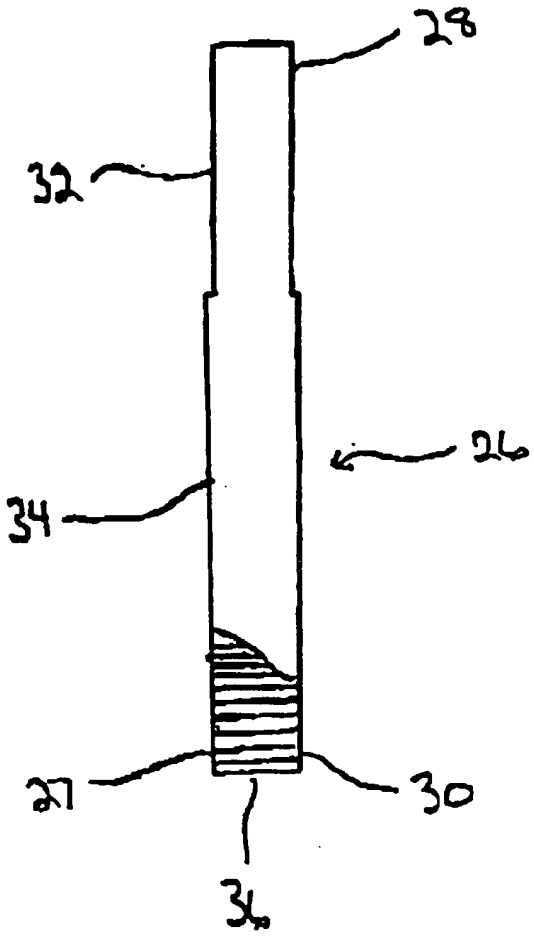



FIGURE 3

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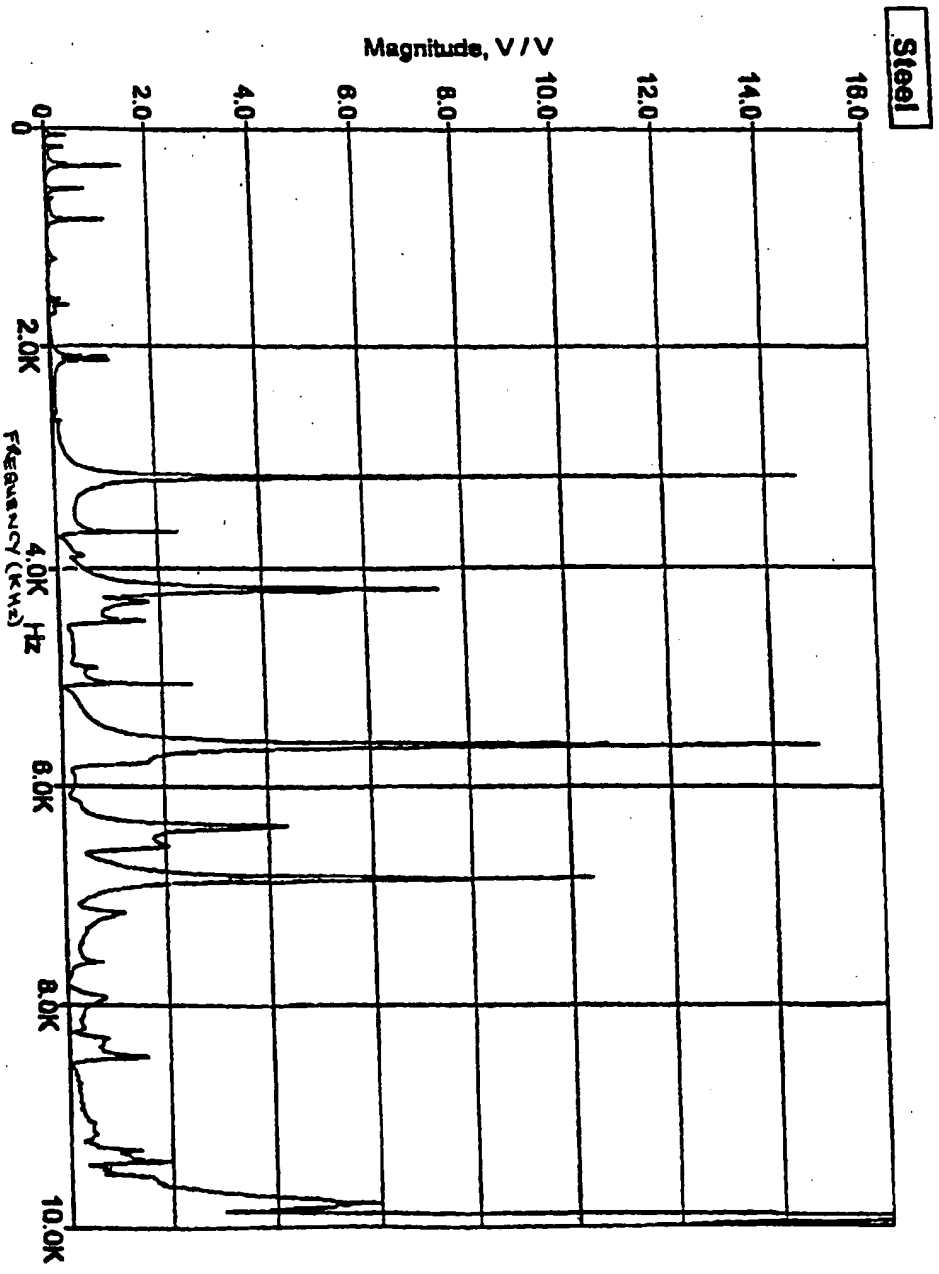
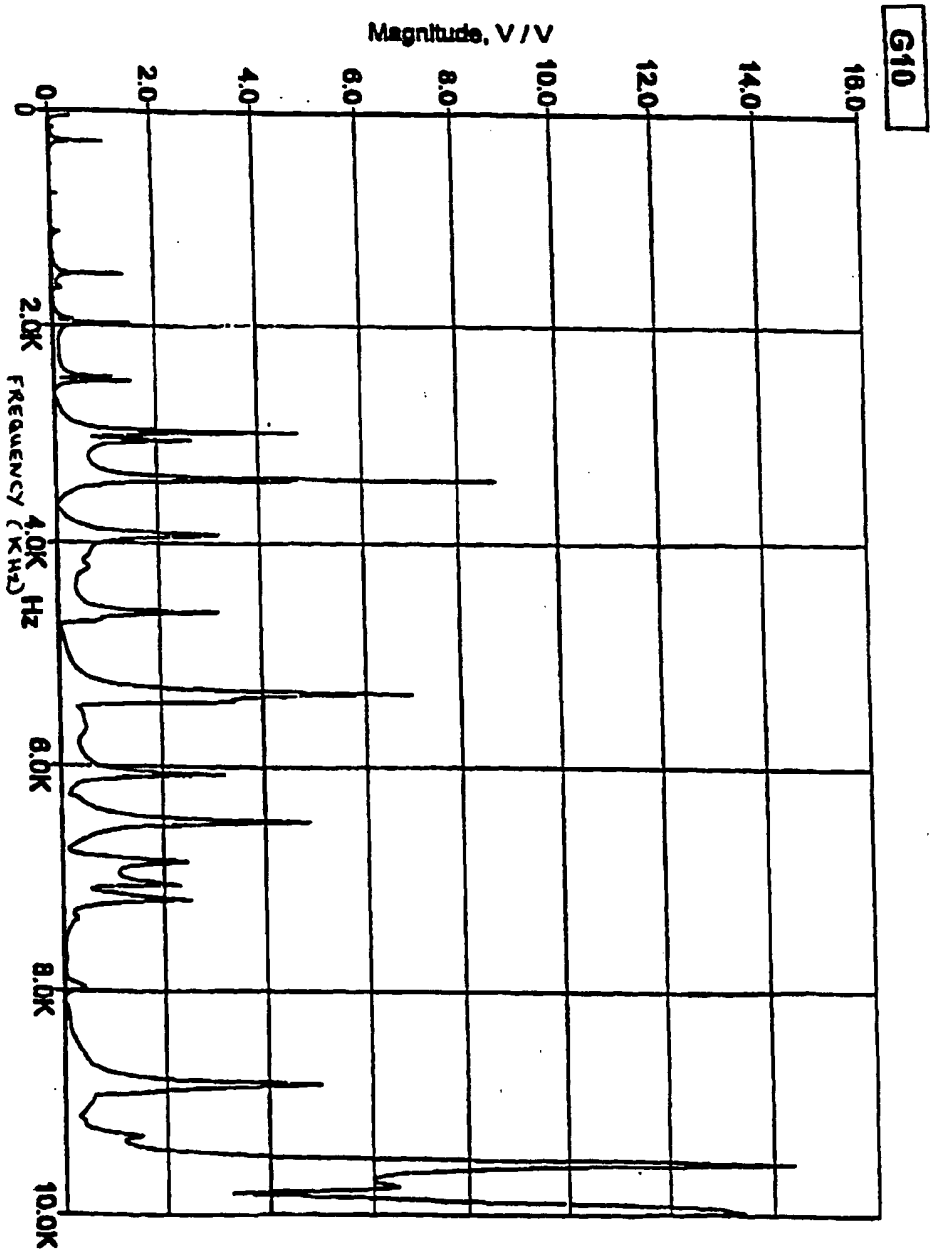



FIGURE 4


G10
Magnitude, V / V
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2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
0
2.0K
4.0K
6.0K
8.0K
10.0K
FREQUENCY (KHz)
Hz

FIGURE 5

DERWENT-ACC-NO: 2002-646732

DERWENT-WEEK: 200270



TITLE: Shaft for golf club, has specific number of equally spaced nickel titanium fibers interposed between several carbon fiber layers which are concentrically laminated

PATENT-ASSIGNEE: YONEX KK[YONEN]

PRIORITY-DATA: 1999JP-0301266 (October 22, 1999)

PATENT-FAMILY:

| PUB-NO | PUB-DATE | LANGUAGE | PAGES | MAIN-IPC |
|---|---|---|---|---|
| JP 2001120697 A | May 8, 2001 | | 003 | A63B 053/10 |

N/A

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|---|---|---|---|
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| 1999JP-0301266 | | October 22, 1999 | |

INT-CL (IPC): A63B053/10, B32B001/08 , B32B005/02

ABSTRACTED-PUB-NO: JP2001120697A

BASIC-ABSTRACT:

NOVELTY - The golf club shaft (2) is formed by laminating concentrically several carbon fiber layers (4a, 4b). 6-10 nickel titanium fibers (6) are interposed between the carbon fiber layers. The nickel titanium fibers are arranged parallely in axial direction and surrounds the shaft at equal interval.

USE - Shaft for golf club.

ADVANTAGE - The nickel titanium fibers have good elastic stability compared with carbon fibers and accumulate a large amount of elastic energy when the shaft is bent by swing. The accumulated energy is released at a time when the ball is stuck, thereby increasing the speed of the head such that the ball travels far.

DESCRIPTION OF DRAWING(S) - The figure shows the golf club shaft.

Golf club shaft 2

Carbon fiber layers 4a, 4b

Nickel titanium fiber 6

CHOSEN-DRAWING: Dwg.1/1

TITLE-TERMS: SHAFT GOLF CLUB SPECIFIC NUMBER EQUAL SPACE NICKEL TITANIUM FIBRE
INTERPOSED CARBON LAYER CONCENTRIC LAMINATE

DERWENT-CLASS: L02 M26 P36 P73

CPI-CODES: L02-J01; M26-B08; M26-B08T;

SECONDARY-ACC-NO:
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Non-CPI Secondary Accession Numbers: N2002-511473